Alt.No.1
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\documents and settings\user\my documents\haestad\santa is.fm2
Worksheet	Velocity and Flow Calculations(alt.no.1)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.045000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft

Results		
Discharge	48.73	cfs
Flow Area	3.00	ft²
Wetted Perimeter	5.47	ft
Top Width	5.00	ft
Critical Depth	1.83	ft
Critical Slope	0.002788	ft/ft
Velocity	16.24	ft/s
Velocity Head	4.10	ft
Specific Energy	5.10	ft
Froude Number	3.70	
Flow is supercritical.		

Alt No. 2
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\documents and settings\user\my documents\haestad\santa is.fm2
Worksheet	Velocity and Flow Calculations(alt.no.2)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.060000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft

Results		
Discharge	56.26	cfs
Flow Area	3.00	ft²
Wetted Perimeter	5.47	ft
Top Width	5.00	ft
Critical Depth	1.95	ft
Critical Slope	0.002737	ft/ft
Velocity	18.75	ft/s
Velocity Head	5.47	ft
Specific Energy	6.47	ft
Froude Number	4.27	
Flow is supercritical.		

Alt.No.2a
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	Velcity And Flow Calculations(alt.no.2a)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.100000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft

Results		
Discharge	72.64	cfs
Flow Area	3.00	ft²
Wetted Perimeter	5.47	ft
Top Width	5.00	ft
Critical Depth	2.18	ft
Critical Slope	0.002649	ft/ft
Velocity	24.21	ft/s
Velocity Head	9.11	ft
Specific Energy	10.11	ft
Froude Number	5.51	
Flow is supercritical.		

Alt.No. 3
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\documents and settings\user\my documents\haestad\santa is.fm2
Worksheet	Alt.No.3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.045000	ft/ft
Depth	2.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft

Results		
Discharge	309.39	cfs
Flow Area	12.00	ft²
Wetted Perimeter	10.94	ft
Top Width	10.00	ft
Critical Depth	3.84	ft
Critical Slope	0.002180	ft/ft
Velocity	25.78	ft/s
Velocity Head	10.33	ft
Specific Energy	12.33	ft
Froude Number	4.15	
Flow is supercritical.		

Alt.No.4
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	Velocity and Flow Calculations
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.060000	ft/ft
Depth	2.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft

Results		
Discharge	357.25	cfs
Flow Area	12.00	ft²
Wetted Perimeter	10.94	ft
Top Width	10.00	ft
Critical Depth	4.10	ft
Critical Slope	0.002141	ft/ft
Velocity	29.77	ft/s
Velocity Head	13.77	ft
Specific Energy	15.77	ft
Froude Number	4.79	
Flow is supercritical.		

Alt.No.4a
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	Velocity and Flow Calculations(alt.no.4a
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.100000	ft/ft
Depth	2.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft

Results		
Discharge	461.21	cfs
Flow Area	12.00	ft²
Wetted Perimeter	10.94	ft
Top Width	10.00	ft
Critical Depth	4.59	ft
Critical Slope	0.002071	ft/ft
Velocity	38.43	ft/s
Velocity Head	22.96	ft
Specific Energy	24.96	ft
Froude Number	6.19	
Flow is supercritical.		

Alt.No.5
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	Velocity and Flow Calculations(alt.no.5)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.045000	ft/ft
Depth	3.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft

Results		
Discharge	781.67	cfs
Flow Area	24.00	ft²
Wetted Perimeter	15.42	ft
Top Width	14.00	ft
Critical Depth	5.77	ft
Critical Slope	0.001935	ft/ft
Velocity	32.57	ft/s
Velocity Head	16.48	ft
Specific Energy	19.48	ft
Froude Number	4.39	
Flow is supercritical.		

Alt.No.6
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	Velocity and Flow Calculations(alt.no.6)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.060000	ft/ft
Depth	3.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft

Results		
Discharge	902.59	cfs
Flow Area	24.00	ft²
Wetted Perimeter	15.42	ft
Top Width	14.00	ft
Critical Depth	6.14	ft
Critical Slope	0.001899	ft/ft
Velocity	37.61	ft/s
Velocity Head	21.98	ft
Specific Energy	24.98	ft
Froude Number	5.06	
Flow is supercritical.		

Alt.No.7
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	Velocity and Flow Calculations(alt.no.7)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.045000	ft/ft
Depth	2.50	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.50	ft

Results		
Discharge	560.96	cfs
Flow Area	18.75	ft²
Wetted Perimeter	13.68	ft
Top Width	12.50	ft
Critical Depth	4.89	ft
Critical Slope	0.002015	ft/ft
Velocity	29.92	ft/s
Velocity Head	13.91	ft
Specific Energy	16.41	ft
Froude Number	4.31	
Flow is supercritical.		

Alt.No.8
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	Velocity and Flow Calculations(alt.no.8)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.060000	ft/ft
Depth	2.50	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.50	ft

Results		
Discharge	647.74	cfs
Flow Area	18.75	ft²
Wetted Perimeter	13.68	ft
Top Width	12.50	ft
Critical Depth	5.21	ft
Critical Slope	0.001978	ft/ft
Velocity	34.55	ft/s
Velocity Head	18.55	ft
Specific Energy	21.05	ft
Froude Number	4.97	
Flow is supercritical.		

07/03/12

C3.4 V CHANNEL SIZING CALCULATIONS

V-shaped channels as shown in Figure C3-2 are proposed. The sides will be sloped at 2:1 (H:V) (50%). The channels will be covered with erosion control blanket (or an approved equal) to minimize erosion.

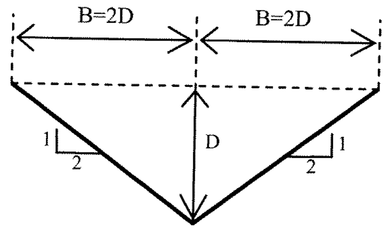

Figure C3-2. Schematic of the proposed V channel

The flow rates of the channels were calculated using the flow equation.

$$Q = AV$$

Where,

A = Area of the flow= $\frac{1}{2} \times D \times (2D+2D) = 2D^2$

And $V = \frac{1}{n}(R_H)^{2/3} s^{1/2}$

Where,

V = average flow velocity (m/s)

s = slope

n=Manning's roughness coefficient = 0.035 for (assumed for energy dissipator)

R_H = Hydraulic radius= A / W

W = wetted perimeter = $\sqrt{D^2 + (2D)^2} + \sqrt{D^2 + (2D)^2}$

$= (\sqrt{5} + \sqrt{5})D = 5D$

$R_H = 2D^2 / 5D = 0.4D$

$V = \frac{1}{n}(0.4D)^{2/3} s^{1/2} = 15.51D^{2/3} s^{1/2}$

$Q = 2D^2 \times 21.72D^{2/3} s^{1/2} = 31.02D^{8/3} s^{1/2}$ m³/s

The table below presents the proposed dimensions and flow rate carrying for the proposed earth channels along with the maximum tractive stress.

Table C3-3. Dimensions, flow rates, and others for the proposed V channels

CHANNEL ID	Peak Discharge Rate		Average Slope (%)	Proposed Depth D		Flow Rate Capacity (m^3/s) ($31.02D^{8/3}s^{1/2}$)	Flow Depth At Peak Discharge Rate (m)	Maximum Tractive Stress (kN/m^2)
	ft^3/s	m^3/s		inches	m			
1 / 2	73.84	2.10	4.5	24	0.60	2.97	0.53	0.72
2 / 2	48.55	1.38	4.5	18	0.45	1.65	0.42	0.60
4	41.60	1.18	11	18	0.45	1.22	0.44	0.48
6	81.14	2.30	11	24	0.60	2.64	0.57	0.62
8	15.51	0.44	4	18	0.45	0.74	0.37	0.15
9	88.00	2.49	18	24	0.60	3.37	0.54	0.95

Felipe Nazario & Asociados
Engineers, Planners, Environmental Consultants
Box 3871, Guaynabo, P.R. 00970
Phone: (787) 773-0730 Fax: (787) 625-3716
e-mail: www.felipenazario@yahoo.com

Santa Isabel Landfill

EXISTING PIPE CAPACITIES

C4.1 OVERVIEW

The objective of the calculations presented in this section is to determine the capacities of the existing pipes within the landfill. A 54" Ø reinforced concrete pipe crossed the landfill from north to south in two sections while a 24" Ø corrugated pipe is running parallel to the property limit in the east along a short length also discharging finally into the south.

C4.2 CRITERIA(S) OR CONSTRAINT(S)

The pipes must be large enough to deliver the collected storm water into the existing watercourse in the south at a rate equal to or greater than the discharge rate (25-year, 24-hours).

C4.3 METHODOLOGY

Manning's equation (eqn C4-1) and the continuity equation (eqn C4-2) were used to determine the capacities of the existing pipes.

$$V = \frac{R^{2/3}\, i^{1/2}}{n} \qquad \text{(C4-1)}$$

$$Q = VA_W \qquad \text{(C4-2)}$$

Where,

V = average flow velocity (m/s),

R = hydraulic radius,

s = Slope of pipe,

n = Manning's roughness coefficient,

Q =flow rate (m^3/s), and

A_w = cross-sectional area of the flow (m^2).

C4.4 RESULTS

On the following pages of this section we are presenting the hydraulics outputs of the existing pipes within the landfill.

Table C4-1 presents the peak discharge rate that drains toward the existing pipes and the capacities of the existing storm infrastructure.

Table C4-1

Area ID	Peak Discharge (cfs)	Maximum Discharge of Pipe (cfs)	Comment
3	531.83	561.31	Good
5	573.42	422.54	Detention pond is required
9	88.00	36.10	Removal of existing pipe is needed
9	88.00	96.26	Installation of a New 24" Ø HDPE pipe is required

54"RCP FIRST SECTION
Worksheet for Circular Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	54"RCP FIRST SECTION
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.012	
Channel Slope	0.060000	ft/ft
Depth	4.50	ft
Diameter	54.00	in

Results		
Discharge	521.80	cfs
Flow Area	15.90	ft²
Wetted Perimeter	14.14	ft
Top Width	0.13e-6	ft
Critical Depth	4.49	ft
Percent Full	100.00	
Critical Slope	0.057371	ft/ft
Velocity	32.81	ft/s
Velocity Head	16.73	ft
Specific Energy	21.23	ft
Froude Number	0.52e-3	
Maximum Discharge	561.31	cfs
Full Flow Capacity	521.80	cfs
Full Flow Slope	0.060000	ft/ft
Flow is subcritical.		

54"RCP SECOND SECTION
Worksheet for Circular Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	54"RCP SECOND SECTION
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.012	
Channel Slope	0.034000	ft/ft
Depth	4.50	ft
Diameter	54.00	in

Results		
Discharge	392.80	cfs
Flow Area	15.90	ft²
Wetted Perimeter	14.14	ft
Top Width	0.13e-6	ft
Critical Depth	4.46	ft
Percent Full	100.00	
Critical Slope	0.031476	ft/ft
Velocity	24.70	ft/s
Velocity Head	9.48	ft
Specific Energy	13.98	ft
Froude Number	0.39e-3	
Maximum Discharge	422.54	cfs
Full Flow Capacity	392.80	cfs
Full Flow Slope	0.034000	ft/ft
Flow is subcritical.		

24"CORRUGATED PIPE
Worksheet for Circular Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	24"CORRUGATED PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.075000	ft/ft
Depth	2.00	ft
Diameter	24.00	in

Results		
Discharge	33.56	cfs
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.6e-7	ft
Critical Depth	1.91	ft
Percent Full	100.00	
Critical Slope	0.065063	ft/ft
Velocity	10.68	ft/s
Velocity Head	1.77	ft
Specific Energy	3.77	ft
Froude Number	0.26e-3	
Maximum Discharge	36.10	cfs
Full Flow Capacity	33.56	cfs
Full Flow Slope	0.075000	ft/ft
Flow is subcritical.		

24"HDPE PIPE
Worksheet for Circular Channel

Project Description	
Project File	c:\docume~1\user\my documents\haestad\fm\santa is.fm2
Worksheet	24"HDPE PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.075000	ft/ft
Depth	2.00	ft
Diameter	24.00	in

Results		
Discharge	89.48	cfs
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.6e-7	ft
Critical Depth	2.00	ft
Percent Full	100.00	
Critical Slope	0.073033	ft/ft
Velocity	28.48	ft/s
Velocity Head	12.61	ft
Specific Energy	14.61	ft
Froude Number	0.69e-3	
Maximum Discharge	96.26	cfs
Full Flow Capacity	89.48	cfs
Full Flow Slope	0.075000	ft/ft
Flow is subcritical.		

Appendix D

Technical Specifications

Technical Specifications

For

Revised Closure Plan for the Santa Isabel Municipal Solid Waste Landfill

Prepared by:

LANDFILL GAS TECHNOLOGIES CORP.

Municipality of Santa Isabel

Prepared For

United States Environmental Protection Agency

Administrative Order on Consent
Docket No. RCRA-02-2011-7303

TABLE OF CONTENTS
TECHNICAL SPECIFICATIONS

SECTION 01050

FIELD ENGINEERING

SECTION 01050

FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: Provide such field engineering services as are required for proper completion of the Work including, but not necessarily limited to:

1. Establishing and maintaining lines and levels.

2. Structural design of shores, forms, and similar items provided by the Contractor as part of his means and methods of construction.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Supplementary Conditions.

2. Additional requirements for field engineering also may be described in other Sections of these Specifications.

3. The Owner will furnish survey describing the physical characteristics, legal limitations, utility locations, and legal description of the site.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 REFERENCES

A. Comply with pertinent provisions of Section 01340.

B. Upon request of Engineer, submit:

1. Data demonstrating qualifications of persons proposed to be engaged for field engineering services.

2. Documentation verifying accuracy of field engineering work.

3. Certification, signed by the Contractor's retained field engineer, certifying that elevations and locations of improvements are in conformance or nonconformance with requirements of the Contract Documents.

1.04 PROCEDURES

A. In addition to procedures directed by the Contractor for proper performance of the Contractor's responsibilities:

1. Locate and protect control points before starting work on the site.

2. Preserve permanent reference points during progress of the work.

3. Do not change or relocate reference points or items of the work without specific approval from the Engineer.

4. Promptly advise the Engineer when a reference point is lost or destroyed, or requires relocation because of other changes in the work.

    a. Upon direction of the Engineer, require the field engineer to replace reference stakes or markers.

    b. Locate such replacements according to the original survey control.

[END OF SECTION]

SECTION 01085

APPLICABLE STANDARDS

SECTION 01085

APPLICABLE STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Throughout the Contract Documents, reference is made of codes and standards which establish qualities and types of workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.

2. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is the Contractor's responsibility to provide materials and workmanship which meet or exceed the specifically named code or standard.

3. It is also the Contractor's responsibility, when so required by the contract Documents or by written request from the Engineer, to deliver to the Engineer all required proof that the materials or workmanship, or both, meet or exceed the requirements of the specifically named code or standard. Such proof shall be in the form requested in writing by the Engineer, and generally will be required to be copies of a certified report of tests conducted by a testing agency approved for that purpose by the Engineer.

B. Related work: Specific naming of codes or standards occurs on the Drawings and in other Sections of these Specifications.

1.02 QUALITY ASSURANCE

A. Familiarity with pertinent codes and standards: In procuring all items used in this Work, it is the contractor's responsibility to verify the detailed requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.

B. Rejection of non-complying items: The Engineer reserves the right to reject items incorporated into the Work which fail to meet the specified minimum requirements. The Engineer further reserves the right, and without prejudice to other recourse the Engineer may take, to accept non-complying items subject to an adjustment in the Contract Amount as approved by the Engineer and the Owner.

C. Applicable standards listed in these Specifications include, but are not necessarily limited to, standards promulgated by the following agencies and organizations:

1. ACI = American Concrete Institute, Box 19150, Redford Station, Detroit, Michigan 48129.

2. AISC = American Institute of Steel Corporations, Inc., 1221 Avenue of the Americas, New York, New York 10020.

3. ANSI = American National Standards Institute (successor to USASI and ASA), 1430 Broadway, New York, New York 10018.

4. ASTM = American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

5. AWS = American Welding Society, Inc., 2501 N.W. 7th Street, Miami, Florida 33125.

6. CRSI = Concrete Reinforcing Steel Institute, 228 North LaSalle Street, Chicago, Illinois 60610.

7. CS = Commercial Standard of NBS, U.S. Department of Commerce Government Printing Office, Washington, D.C. 20402.

8. FGMA = Flat Glass Marketing Association, 3310 Harrison, Topeka, Kansas 66611.

9. NAAMM = National Association of Architectural Metal Manufacturers, 1033 South Boulevard, Oak Park, Illinois 60302.

10. NEC = National Electric Code (see NFPA).

11. NEMA = National Electrical Manufacturers Association, 155 East 44th Street, New York, New York 10017.

12. NFPA = National Fire Protection Association, 470 Atlantic Avenue, Boston, Massachusetts 02210.

13. SDI = Steel Deck Institute, 135 Addison Avenue, Elmhurst, Illinois 60125.

14. SSPC = Steel Structures Painting Council, 4400 5th Avenue, Pittsburgh, Pennsylvania 15213.

15. TCA = Tile Council of America, Inc., P.O. Box 326, Princeton, New Jersey 08540.

16. UL = Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Illinois 60611.

17. Fed Specs and Fed Standards: Specifications Sales (3FRI), Bldg. 197, Washington Navy Yard, General Services Administration, Washington, D. C. 20407.

18. UBC = Uniform Building Code, International Conference of Building Officials, 5360 South Workman Mill Road, Whittier, California 90601.

[END OF SECTION]

W = wetted perimeter = $\sqrt{D^2+(2D)^2}+\sqrt{D^2+(2D)^2}$

$=(\sqrt{5}+\sqrt{10})D = 5.40D$

$R_H = 2.5D^2 / 5.40D = 0.463D$

$V = \frac{1}{n}(0.463D)^{2/3} s^{1/2} = 3.385D^{2/3}$

$Q = 2.5D^2 \times 3.385D^{2/3} = 8.46D^{8/3}\ m^3/s$

Another consideration that should be assessed when designing stormwater berms is erosion potential. Velocity and tractive stresses are the two criteria that are used to characterize the erosion potential of channels. Native grass lining is proposed for diversion berms. Fischenich (2001) reported that the tractive stresses for a native grass-lined channel should be less than 0.06 KN/m^2 to 0.08 KN/m^2 (1.2 lb/ft^2 to 1.7 lb/ft^2) to limit erosion. Similarly, the flow velocity in a grass-lined channel should be less than 1.2 to 1.83 m/s to limit erosion. Tractive stresses were calculated using the following equation for the maximum stormwater flow rate achieved in the diversion berm:

$$\tau = \gamma_w \times D \times S$$

Where,

τ = tractive stresses, kN/m^2

γ_w = unit weight of water, 9.807 kN/m^3

D = depth of flow, m

S = longitudinal slope (2%)

Table C2-3 presents the proposed dimensions and flow rate carrying for the proposed berms along with the maximum tractive stress. The maximum tractive stress (τ_{max}) and fluid velocity (V_{max}) were calculated to be within the ranges reported by Fischenich (2001). Therefore, native grass lining was found to be appropriate for the proposed berms.

Table C2-3. Dimensions, flow rates, and tractive stresses for the proposed berms

Berm Catchment Area	Depth D		Width B = 3D		Q (m^3/s) ($8.46D^{8/3}$)	V_{max} (m/s)	τ_{max} (kN/m^2)
	m	inches	m	inches			
Low Capacity	0.25	10”	0.75	30”	0.15	1.4	0.049
Medium Capacity	0.30	12”	0.90	36”	0.32	1.6	0.059
High Capacity	0.40	16”	1.20	48”	0.61	1.8	0.076

C2.4 REFERENCES

Fischenich, C. (2001). Stability Thresholds for Stream restoration Materials. EMRRP Technical Notes Collection: ERDS TN-EMRRP-SR-29. US Army Corp of Engineers Research and Development Center.

Linsley, R.K. and J. B. Franzini (1964). Water Resources Engineering. MgGraw-Hill, New York.

Felipe Nazario & Asociados
Engineers, Planners, Environmental Consultants
Box 3871, Guaynabo, P.R. 00970
Phone: (787) 773-0730 Fax: (787) 625-3716
e-mail: www.felipenazario@yahoo.com

Santa Isabel Landfill

CONCRETE CHANNEL SIZING CALCULATIONS

C3.1 OVERVIEW

The objective of the calculations presented in this section is to design the concrete channel size needed for the designed stormwater conveyance system. The stormwater trapezoidal channels will be constructed at the northern periphery, upstream of the existing 54" Ø RCP's and downstream of existing concrete pipe in the south of the facility. Otherwise, the V-shaped channels will be constructed at the peripheries in the east and the west, and along the right side of the existing access road.

C3.2 DESIGN FLOW RATE

Table C3-1 presents the flow rates the proposed channels will be designed to handle. Refer to Appendix C1 (Table C1-3) for details on the flow rate estimations and drawings in Figure C1-3 for channel locations.

Table C3-1. Design Flow Rates for Channels

Channel ID	Peak Discharge Rate (ft^3s)	Peak Discharge Rate (m^3s)
1 *	147.68	4.19
2 *	97.09	2.75
3 *	531.83	15.07
4	41.60	1.18
5 *	573.42	16.25
6	81.14	2.30
7 *	654.57	18.55
8	15.51	0.44
9	88.00	2.49

* Trapezoidal Channel. V channels are identified without the asterisk (*).